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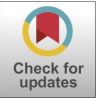


Actualization list of species of the genus *Tityus* (Scorpionida: Buthidae) (Koch, 1843) in Bolivia

Actualización de la lista de especies del género *Tityus* (Escorpionida: Buthidae)

(Koch, 1843) en Bolivia

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Abstract

The scorpions of the genus *Tityus* are a group widely distributed throughout the world, having greater richness and diversity in South America, they are of medical importance in the region, however they have been little studied in Bolivia. A review of the specimens of the Immunoglobulin Production Laboratory of INLASA was carried out, using different dichotomous keys of the genus from Latin America, as well as the study of the original descriptions of some species described for Bolivia. An updated list of *Tityus* species from Bolivia is presented, 9 species are mentioned with their respective localities: *T. argentinus* (Villa Tunari and Chapare in Cochabamba, Buena Vista and Campeche in Santa Cruz and in the Chaco of Chuquisaca), *T. birabeni* (Villa Tunari, Cochabamba), *T. bolivianus* (Tipuani, La Paz), *T. confluens* (Villa Montes, Tarija), *T. horacioi* (San Mateo, Cochabamba), *T. kaderkai* (Rurrenabaque and San Joaquín, Beni), *T. proseni* (Locotal, Cochabamba), *T. sorataensis* (Sorata, Cheje and Quime, La Paz) and the presence of *T. metuendus* is confirmed for Bolivia in the department of Pando. Thus, the number of *Tityus* species for the Bolivian territory was updated, as well as the distribution of *T. metuendus*.

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Resumen

Los escorpiones del género *Tityus* son un grupo ampliamente distribuido a lo largo del mundo teniendo mayor riqueza y diversidad en Sudamérica, estos son de importancia medica en la región sin embargo han sido poco estudiados en Bolivia. Se realizó una revisión de los ejemplares del Laboratorio de Producción de Inmunoglobulinas de INLASA, mediante el uso de diferentes claves dicotómicas del género provenientes de Latinoamérica, así como el estudio de las descripciones originales de algunas especies descritas para Bolivia. Se presenta una lista actualizada de las especies de *Tityus* de Bolivia se mencionan 9 especies con sus respectivas localidades: *T. argentinus* (Villa Tunari y Chapare en Cochabamba, Buena Vista y Campeche en Santa Cruz y en el Chaco de Chuquisaca), *T. birabeni* (Villa Tunari, Cochabamba), *T. bolivianus* (Tipuani, La Paz), *T. confluens* (Villa Montes, Tarija), *T. horacioi* (San Mateo, Cochabamba), *T. kaderkai* (Rurrenabaque y San Joaquín, Beni), *T. proseni* (Locotal, Cochabamba), *T. sorataensis* (Sorata, Cheje y Quime, La Paz) y se confirma la presencia de *T. metuendus* para Bolivia en el departamento de Pando. De esta forma, se actualizó el número de especies de *Tityus* para el territorio boliviano, como la distribución de *T. metuendus*.

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Introduction

Scorpions are arthropods widely distributed in tropical, subtropical and desert areas of the world. In recent decades they have proliferated in urban and intra-domiciliary environments, some examples of which have occurred in Brazil and Argentina¹⁻⁴. Regarding the colonization of urban environments, there is no information available for Bolivia.

Of the 22 families of scorpions, Buthidae is the most diversified on the planet and the only one that contains species potentially dangerous to humans⁵⁻⁷. The family Buthidae is distributed throughout the world with the exception of New Zealand and the poles.

The family has 80 genera and 972 described species^{2,4,8,9}. One of the most important genera of Buthidae is the genus *Tityus* C. L. Koch 1836. L. Koch 1836, which has 204 species¹⁰ distributed in Central and South America, with greater richness and diversity in the latter.

Studies of the genus in Bolivia began with the description of *T. bolivianus* Kraepelin (1895) and of the Bolivianus Complex by Kraepelin¹¹. Subsequently^{12,13} he added two new species *T. proseni* and *T. birabeni* respectively. In 1985, Lourenço & Maury¹⁴ in their work on the Bolivianus Complex cited 3 species belonging to this complex *T. argentinus*, *T. bolivianus* and *T. sorataensis*. Later Acosta & Ochoa¹⁵ listed the Bolivian scorpions, citing 8 of the genus *Tityus* for the region. In the same year¹⁶ they refuted the presence of *T. gasci* and *T. metuendus* for Bolivia, reducing the list to 6 species.

In 2005 Kovařík¹⁷ described *T. kaderkai*, the following year Lourenço¹⁰ proposed dividing the genus *Tityus* into 5 subgenera where he dispersed the Bolivian species into the subgenera *Archaeotityus*, *Atreus* and *Tityus*. The last species described for Bolivia in 2011 was *T. horacioi* by Lourenço & Leguin¹⁸ with a total of 8 species.

Bolivia has very little information related to scorpion diversity, most of the references come from original descriptions, being most of them very old. It should also be noted that, in many cases, since the original description, no collections of new individuals have been made to strengthen taxonomic knowledge of these species. In addition, knowing the number of Bolivian species will allow the development of research in other fields, such as biochemical and ecological medicine, given that the taxonomic identity of the species is always required, and future studies on Bolivian species could provide a glimpse of the lethality of the species.

The aim of this research was to present an updated list of the scorpions of the genus *Tityus* for Bolivia. Additionally, to confirm the presence of *Tityus metuendus* for the Bolivian territory by the presence of an individual in the scientific collection of the Laboratory of Immunoglobulin Production (LPI) of the National Institute of Health Laboratories (INLASA).

Materials and methods

For the elaboration of the list, all the works on the genus in the country were reviewed, as well as the original descriptions of some specimens and articles related to the taxonomy of the genus *Tityus*.

Specimens from the INLASA LPI collection were used. Specimens from the INLASA collection were reviewed with the parameters of the dichotomous keys of scorpions from several South American countries, such as Peru¹⁹, Venezuela²⁰, Argentina²¹, Uruguay²² and Brazil^{2,15}, as well as the original descriptions of some species^{12,13,23}. The specimens from INLASA's wet collection were preserved in 70 % alcohol in glass jars according to the size of the individual, covered with rubber stoppers or screw caps

for larger specimens, which were correctly identified and labelled. Each label showed the laboratory code, genus, species and locality. The samples are 10 years old.

Each specimen was examined as carefully as possible to avoid damage, fine-tipped forceps and histological needles were used to handle the specimens, and they were observed under a Ken-a-vision model T-22061 stereomicroscope at 20x and 40x views to ensure their identification.

Additionally, a diagnosis was made for the species *T. metuendus* to corroborate its presence in Bolivian

territory, according to the diagnosis of the original description^{2,23}.

Results

Table 1 presents the updated list of *Tityus* species for Bolivia, the name of the species, the authors who cited or described it in Bolivian territory and then the specimens present in the INLASA collection with their respective code.

Table 1 List of Bolivian *Tityus*

Species	Location	Date of Update	Present at INLASA	Reference
<i>Tityus argentinus</i>	Species for Villa Tunari and Chapare in Cochabamba, Buena Vista in Santa Cruz and in the Chaco of Chuquisaca.	2000, 2023	ILS-E72-82 Campeche, Santa cruz.	14
<i>Tityus birabeni</i>	Describes this species for Villa Tunari, Cochabamba.	1955		13
<i>Tityus bolivianus</i>	Describes this species for Tipuani, La Paz, Species for Tipuani.	1985, 2023	ILS-E221, ILS-E222, ILS-E223 From Tipuani, La Paz.	14,27
<i>Tityus confluens</i>	Species for Villa Montes, Tarija, dry chaco of southern Bolivia.	2019		25,26,28
<i>Tityus horacioi</i>	Citan y describen esta especie para San Mateo, Cochabamba.	2011		18
<i>Tityus kaderkai</i>	Cites and describes this species for Rurrenabaque-Beni.	2005	ILS-E 217 From San Joaquín, Beni.	17
<i>Tityus metuendus</i>	Appointment for the Bolivian Amazon.	2023	ILS-E 37 Procedente de Pando.	23
<i>Tityus proseni</i>	Cites and describes this species for Locotal, Cochabamba.	1954		12
<i>Tityus sorataensis</i>	Cites and describes this species for Sorata, La Paz, this species is cited for Sorata, La Paz, this species is cited for the communities of Cheje and Quime, La Paz.	2021	ILS-E46-63 de Cheje, La Paz; ILS-E100-197 de Quime, La Paz.	11,14,29

Diagnosis: Female 85 mm in total length, dark reddish brown to black colouring along the body. Pro-soma: Carapace granular with marked carinae. Pedipalp: well-marked carinae mobile and fixed finger with 17-18, 15-16 oblique rows of granulites respectively. Mesosoma: sternites and tergites granular with well-defined carinae. Combs: Number of pectinate teeth varies from 19 in females to 20-21 in

males, median basal lamina dilated especially in females. Metasoma: granular with dorsal terminal spine in segments II-IV, carinae arrangement 10-8-8-8-8-8-5, segments IV and V darker, Segment IV slightly higher than segment V. Telson: with strongly curved aculeus, subaculear tooth with broad base and acute tip (conoid). Sexual dimorphism: Males have a

thicker and higher pedipalp hand than females, females have a more dilated and rounded median basal lamina.

Tityus metuendus. Material examined 1 specimen ILS-E 37 From Pando (Figure 1).

Figure 1 a) dorsal view prosome and mesosome, b) ventral view prosome and mesosome, c) dorsal lateral view metasome.



Discussion

The first study of scorpions of the genus *Tityus* in Bolivia was carried out by Kraepelin in 1895 describing *T. bolivianus* which was used as a reference species for the description of the Bolivianus Complex by the same author in 1911. From then on, several changes were made in the complex, initially adding species, then reducing them by synonymies with taxonomic works such as *T. andianus* and *T. bocki*, which after further revision were considered synonymies of *T. argentinus*¹⁴, reducing the number of Bolivian species. *T. gasci* is a species that was described for French Guiana by Lourenço in 1982²⁴, the same author in 1994 suggested the presence of the species for Bolivia. However, according to Lourenço¹⁶ he refuted the presence of *T. confluens*, *T. gasci* and *T. metuendus* for Bolivia using a potential distribution

criterion in which their distribution would no longer reach Bolivia. In the case of *T. confluens*²⁵ they reaffirmed the presence of this species for Bolivia. Finally, the case of *T. metuendus*¹⁵ cites the species, but requested confirmation. According to Lourenço¹⁶ in his book Scorpions of Brazil, in the section on the distribution of the species he no longer mentions Bolivia in its potential distribution. Now with the ILS-E 37 sample from INLASA, the presence of the species was confirmed for the department of Pando. However, due to the lack of latitude and longitude data, it is not known to which locality it belongs.

With the proposed subgenera of *Tityus*¹⁰ the Bolivian species would be distributed in the following subgenera and their respective species: (Archaeotityus): *T. kaderkai*¹⁷. (*Atreus*): *T. metuendus*²³. (*Tityus*): *T. argentinus*²⁶, *T. birabeni*¹³, *T. bolivianus*²⁷, *T. confluens*²⁶, *T. horacioi*¹⁸, *T. proseni*¹², *T. sorataensis*¹¹. The present work will lay the foundations for future research on the genus *Tityus* in Bolivia, with further compilation of information, as the list could be updated with the addition or removal of species based on taxonomic work.

One of the limitations of the study was the lack of samples of each species cited in this work, in addition to the fact that the samples in the INLASA collection did not have precise geographic data. However, the data present in all the samples were the date and department of origin, as was the case with sample ILS-E 37 of the species *T. metuendus*. While the other samples analyzed ILS-E: 72-82 *T. argentinus*, ILS-E: 221-223 *T. bolivianus*, ILS-E: 217 *T. kaderkai*, ILS-E: 46-63 and ILS-E: 100-197 *T. sorataensis* had additional community and collector data.

One of the species that should be prioritized is *T. confluens*, as this species is of medical interest and has been shown to be a danger to be taken into account due to its venom and its ease of adaptation to urban and intra-domiciliary environments²⁶. *T. birabeni*

and *T. proseni* also need to be found for a re-description, as well as to update the species data with the new morphological characteristics currently in use, given that in the case of these two species we only have samples from the original description and they have not been collected by any other researcher in 68 years.

Scorpions are a very little studied group in the country, most of the work carried out on the group was done by foreign researchers and the reference material is found in foreign museums. Some national collections, such as that of the LPI of INLASA, have a considerable collection, but even so, more research and work is needed in the group to enrich national and international knowledge about scorpions, especially of a group of medical interest in the region, such as the genus *Tityus*.

The list of Bolivian species of *Tityus* is updated, of which to date 9 are known: *T. argentinus*, *T. birabeni*, *T. bolivianus*, *T. confluens*, *T. horacioi*, *T. kaderkai*, *T. metuendus*, *T. proseni* and *T. sorataensis*. The presence of *T. metuendus* in Bolivia in the department of Pando is confirmed, and the geographical distribution of the species is extended. It allows us to know the species of the genus present in the national territory and opens the door to future research on the listed species. With the identification of the INLASA LPI samples, we already have national material of some species such as *T. argentinus*, *T. bolivianus*, *T. kaderkai*, *T. sorataensis* and *T. metuendus*. These can be used by other authors for new research work in other fields.

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This work was self-funded by the Immunoglobulin Production Laboratory of the National Institute of Health Laboratories (INLASA).

Conflicts of interest

All samples used in this work belong to the collection of the Immunoglobulin Production Laboratory of the National Institute of Health Laboratories (INLASA), and do not generate conflicts of interest.

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Ethical considerations

Each sample from the wet collection of the Immunoglobulin Production Laboratory was used with the utmost care, always maintaining the hygiene and integrity of the samples. No collections were made for this study.

Research limitations

Lack of precise geographical data on latitude and longitude. Absence of physical samples of some species.

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